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Place and all the great mathematicians since his time, if he would convince the scientific world. His "third motion" is as inefficient as were the cycles and epicycles of the old Ptolemaic system of astronomy.

And still further, M. Beziau's third motion is impossible from a mechanical standpoint. It is a well-known fact of mechanics that a rotating body can have but one axis of rotation when rotating freely due to its own momentum. If the body be impressed with forces simultaneously or alternately tending to give it motion of rotation about more than one axis a single resultant axis of rotation is produced about which single axis it will continue to rotate until some other impressed force causes a new single resultant axis of rotation. The gyroscope in its various forms is a practical illustration of this fact of mechanics. A force brought to bear tangentially to a meridian line of the rotating body will cause the axis of the body to describe the surface of a double cone, the center of oscillation being the common apex, and this is just what happens to cause nutation and precession by action of the moon and sun. Much more is to be found in the article by M. Beziau which may be criticised from the standpoint of mathematics and physics, but it would be useless to go farther; enough has been said to show how utterly untenable is his theory.

CHARLES H. CHASE.

LANSING, MICH., Aug. 1, 1908.

## ON HYPERSPACE.

*To the Editor of The Monist:*

Although the statement of your position with regard to the question of hyperspace, as given on page 471 of your current volume, is in the main highly satisfactory, it seems to leave something to be desired. When we are confronted by an apparent breach of the law of continuity, it would seem more logical to explain it as the result of a relative rather than an absolute limitation. If I walk three paces and bring up against a stone wall I say, "Here is an obstacle that I can not at present surmount;" I do not say, "This is the end of the universe; there are no more paces beyond." That we are three-dimensional beings living in a three-dimensional world is beyond doubt; but it would appear logical to regard this dimensional limitation not as inherent in the nature of things, but as due to some kind of constraint. In *Knowledge* (London, July, p. 157) H. Stanley Redgrove submits what he regards as a mathematical proof of the infinite dimensionality of space. Without discussing the validity of his reasoning here I submit that his conclusion is in stricter accordance with the laws of continuity than the ordinary assumption. My object in writing this is to make a suggestion regarding the kind of constraint to which our present limitations may be due —a suggestion which at the same time seems to offer a solution of a difficulty that must have presented itself to all students of this question. If matter may exist in a space of higher dimensions than itself, why might not two-dimensional or one-dimensional matter exist in our three-dimensional space? Now although, for argument's sake, two-dimensional matter has often been assumed, I have never seen any suggestion of its possible nature. Let us suppose an ether of three dimensions and matter consisting of modifications of portions of this ether—vortices, strains, or what you will. If these be due to three-dimensional motions, we shall have three-dimensional matter, but if we suppose the ether constrained in such a way that its motion shall be uniplanar (parallel to one plane) then, although the ether itself remains tri-dimensional, the material world due to it will be two-dimensional; in other words, the matter in this world, the natural forces, and so on will have, to all intents and purposes, only two dimensions. The molecules, to be sure, might really have three dimensions—they might be vortex-filaments, for instance; but so far as any mutual interaction is concerned—any sense-perception, for example, exercised by organisms made up of them, their world would be limited to two dimensions. Now, if this be so—and I can see no escape from it—we may in like manner have a four- or five- or infinite-dimensional ether constrained to perform all its motions parallel to a three-flat. Its motion might perhaps be called by analogy "uni-tri-flat." Then we should have the exact counterpart of our present universe; and such I prefer to think that it is. It would seem also perfectly legitimate to speculate about what might happen if the constraint should "slip a cog" and drop down to a four-flat constraint, or if it should be removed altogether.

All this is quite agreeable to your statement that "as soon as we make an *a priori* construction of the scope of our motility, we find out the incompatibility of the whole [four-dimensional] scheme"; only it views the incompatibility as due to some form of constraint and not to the inherent necessity of a tri-dimensional world.

It is evident also, of course, that the idea of such a constraint is quite independent of the particular form that has been given to it in the above suggestion.

Arthur E. Bostwick, Ph. D. (Yale).

New York Public Library, July 27, 1908.

## A COMMENT ON PSEUDO-GEOMETRY.

The article of Mr. Chas. H. Chase on "Pseudo-Geometry" in the last issue of *The Monist* (pp. 465-467) has most certainly been welcomed by all mathematicians, desirous of keeping our infallible science free from absurdities and chimeras. In fact it is surprising how the fallacies of Lobatchevsky and Bolyai could find so many followers. I maintain that Euclid's Ax. XI does not permit the existence of what its promoters call "non-Euclidean geometry" etc. Permit me to prove my position.

Two straight lines in a plane either intersect in one point or they are parallel. This fact is so simple that Euclid did not even deem it necessary to mention it as an axiom; however, it is necessary to bear in mind, that he had no conception of an unlimited space, plane or line, and that he reckoned with *positive* magnitudes exclusively. Intersecting straight lines converge towards their point of intersection and diverge from it, which fact, if the point of intersection lies within the illustration (drawing), can be observed by ocular inspection. It was the practical geodetist Euclid, who gave in his Axiom XI the means to ascertain the direction of convergency, if the point of intersection is at a distance. Now as much as the sum of the two inner angles on the side of convergency is less than two right angles, so much does it exceed 180° on the side of divergency, for the sum of all four of these angles equals 4 right angles. For the case that the sum of the inner angles on either side of the transversal amounts to exactly 2 right angles, this indicates neither convergency nor divergency in either direction: the two lines are *parallel.*

Euclid deduces from Axiom XI the theorem that *parallels intersect any transversal at equal angles,* which he makes use of to prove, that the sum of the three angles of a plane triangle equals 2 right angles. Perhaps it might have been of advantage to give the above wording to the axiom upon which to base the theory of parallels and make the present official wording a scholium.

May these explanations help to expel from exact science a plane that in fact is part of a sphere with an infinite radius, a triangle in